
Run II PMG
Stacking Rapid Response Team Report

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December 2, 2005

We had a plan...

December Study Period

- The purpose of the study period is to beam-base align the AP2 line and the Debuncher.
 - Starting at 08:00:00 on December 5
 - Ending 0:00:00 on December 19.
- Pbar studies 2 shifts a day from 08:00:00 - 23:59:00
 - The first week will focus on alignment of the Debuncher
 - Requires one 5 sec. event every 60 seconds
 - The second week will focus on the AP2 line
 - Requires one 5 sec. event every 10 seconds
 - Will reduce NUMI neutrino flux by 50%
- Stack during the owl shift (00:01:00 - 08:00:00).
 - Do not have enough manpower to staff pbar study shifts around the clock
 - First week: Provide pbars for special luminosity runs for the experiments
 - Second week: Provide pbars for Recycler and Main Injector coalescing studies

December Study Period

- The Booster and Main Injector will provide beam to support pbar studies, pbar stacking, neutrino production and SY120.
 - Will attempt slip stacking of NUMI batches (Proton Plan study)
 - The flux to the neutrino experiments and SY120 may be somewhat reduced depending on the Pbar studies.
 - First week will have little impact on NUMI neutrino flux.
 - Second week will impact NUMI neutrino flux by 50% during Pbar studies
 - Will do 2.5 MHz coalescing studies during the second week
- Recycler
 - First week: stashing pbars in support of collider operations.
 - Second week: stashing pbars in support of 2.5 MHz coalescing studies.
 - Interspersed electron cooling studies

December Study Period

- Tevatron will be providing a couple of special low luminosity runs for the experiments during the first week.
 - CDF requests a 2 shift access on December 5.
 - Dzero requests two stores with 1 proton bunch x 4 antiproton bunch at nominal bunch intensities
 - No low beta squeeze
 - No separated orbits (separators off)
 - Parasitic collisions an issue for the experiment?
 - Might have to try a couple of times because of beam-beam effects
 - » Low number of pbars permits quick turnaround
 - Stores separated by a period of time.
 - Both experiments request a $1\text{-}3 \times 10^{30} \text{cm}^{-2} \text{sec}^{-1}$ store
 - Small emittances
 - Low bunch intensities
 - Proton intensity looks straight forward
 - Questions on performance of feedback loops in the Main injector for pbar acceleration

December Study Period

- Tevatron will do proton only studies during the second week.
- The low luminosity stores are higher priority than Tevatron studies
- Tevatron Studies
 - Move proton tunes above the 7/12 everywhere
 - 2 shifts
 - followed by a normal store as a reality check
 - Move IP longitudinal in CDF
 - Requires swapping trims
 - redo ramps
 - followed by a normal store as a reality check
 - Looking at new working point - Measuring nonlinear content of Tevatron ~1-2 shifts
 - Electron cloud study
 - TEL BPM calibration

December Study Period Organization

- Keith Gollwitzer is in charge of planning the Pbar Studies
- Val Lebedev and Ron Moore will define and coordinate the Tevatron Studies.
- Jim Morgan is in charge of overall machine operation and scheduling.
- We need a lot of input from the collider experiments. The usual collider coordinators will be our main points of contacts.
 - Bill Lee and Taka Yasuda from DZero
 - Patrick Lukens and Willis Sakumoto from CDF
- We are having 3 planning meetings for the December Studies period.
 - The meetings take place at 10am in the Penthouse (Booster West Towers) on Wednesdays
 - November 16, 23, 30
 - The goal for the first meeting is for everybody to voice requests.
 - The goal for the second meeting is to have a draft schedule.
 - The goal for the third meeting is to agree on a final schedule.
 - Present the final schedule at the December 2 Run 2 PMG

November 21

New plan

November 21-December 8 Study Plan

- Scramble
- Pbar
 - Debuncher & AP2 Alignment Studies - Day and Evening Shifts
 - D/A Alignment Studies - Owl Shift
- Main Injector
 - 2.5 MHz Acceleration Studies
 - First week - use up left over Pbars in the Recycler and Accumulator
 - End of first week - Proton studies
 - End of second week - Pbar studies
 - NUMI Slip Stacking
- Recycler
 - Proton only studies
- Tevatron
 - Repair B17
 - Other jobs
 - IPM installation
 - P1 vacuum fix

Pbar Shift Tally (so far)

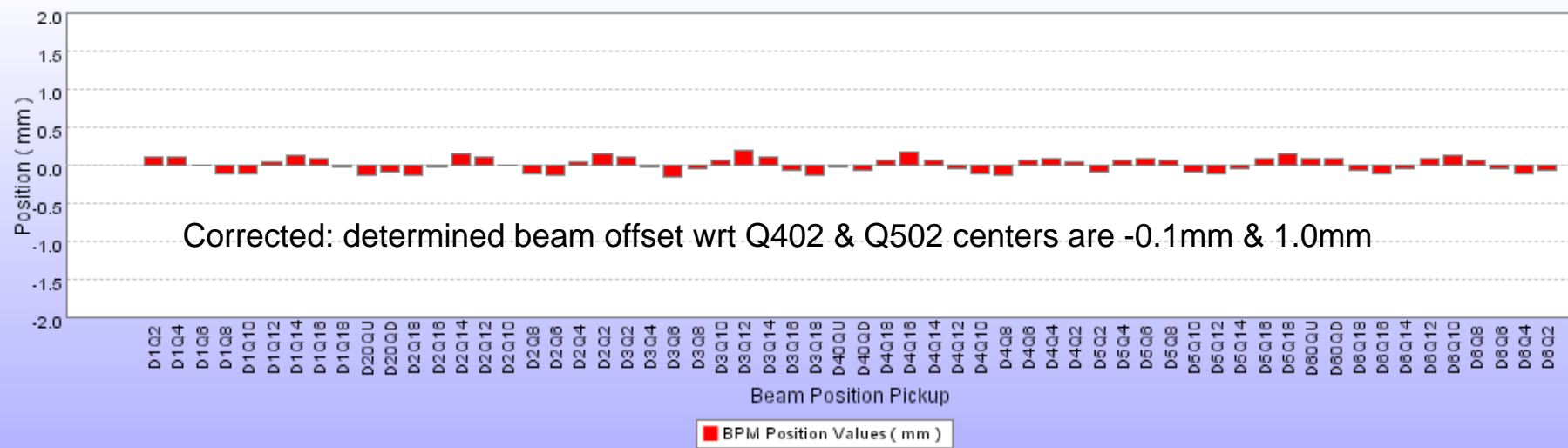
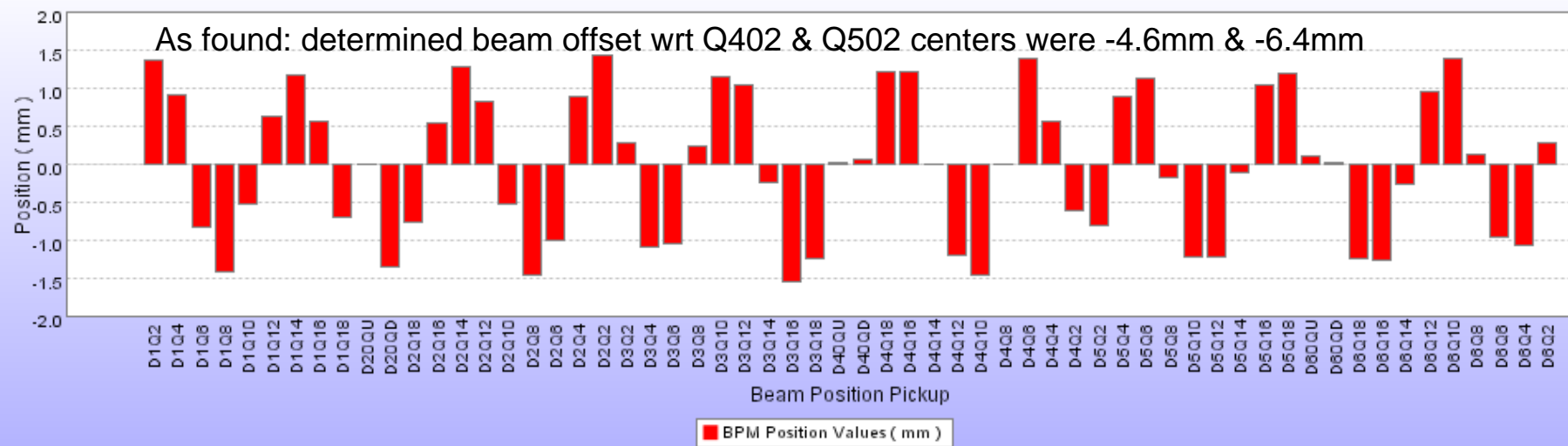
- Reverse Proton Setup - 4 shifts
 - TBT commissioning - 2 shifts
 - BPM check out Debuncher & AP2 - 2 shifts
- AP2 Lattice Measurements - 1 Shift
- Debuncher Vertical Quad Centers - 9 shifts
- Debuncher Vertical Moveable Devices - 4 Shifts (so far)
- D/A Line Beam Based Alignment - 6 Shifts (so far)
- Shutdown - 6 Shifts
 - Thanksgiving - 3 Shifts
 - November 29 Maintenance day - 3 shifts

Pbar Studies Summary

- AP2 Lattice Measurements
 - See a fairly significant lattice mismatch (30%) at the end of the line - Quad gradients not fitting to design
- Debuncher vertical beam based alignment
 - More than 750 orbits taken
 - Orbits with different quad excitations to determine orbit offset wrt to quad centers
 - Orbits taken during the correction phase of procedure to verify locality of correction
 - Correction iterative due to some offsets in quads are constraints as well as the quad is a corrector
 - Orbits with different quad excitation to verify reduction of orbit offset
 - 65 of 114 quads are capable of quad excitations (alone or in pairs)
 - Average ABS(offset) reduced from 2.7mm to 0.6mm

Debuncher Vertical Beam Based Alignment

Differential orbits due to 4% change in excitation current for Q402 and Q502



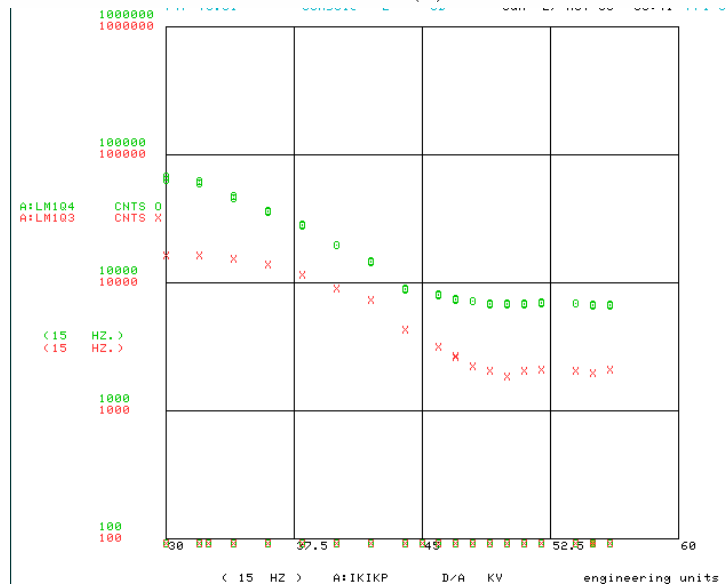
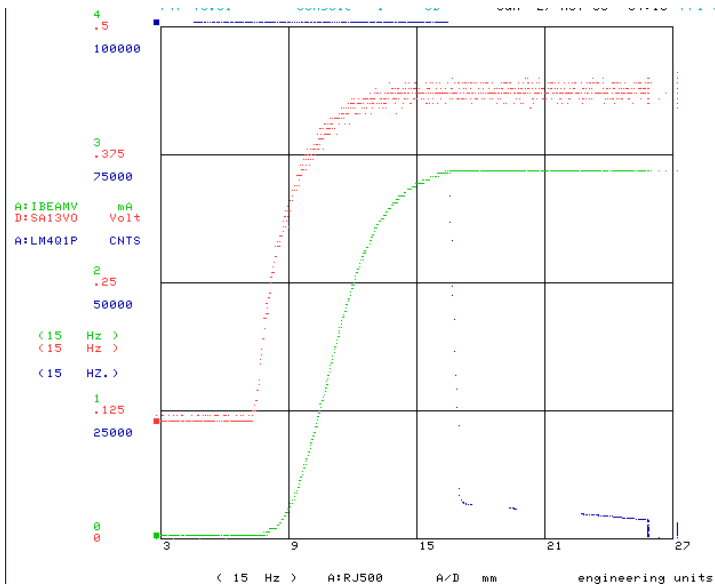
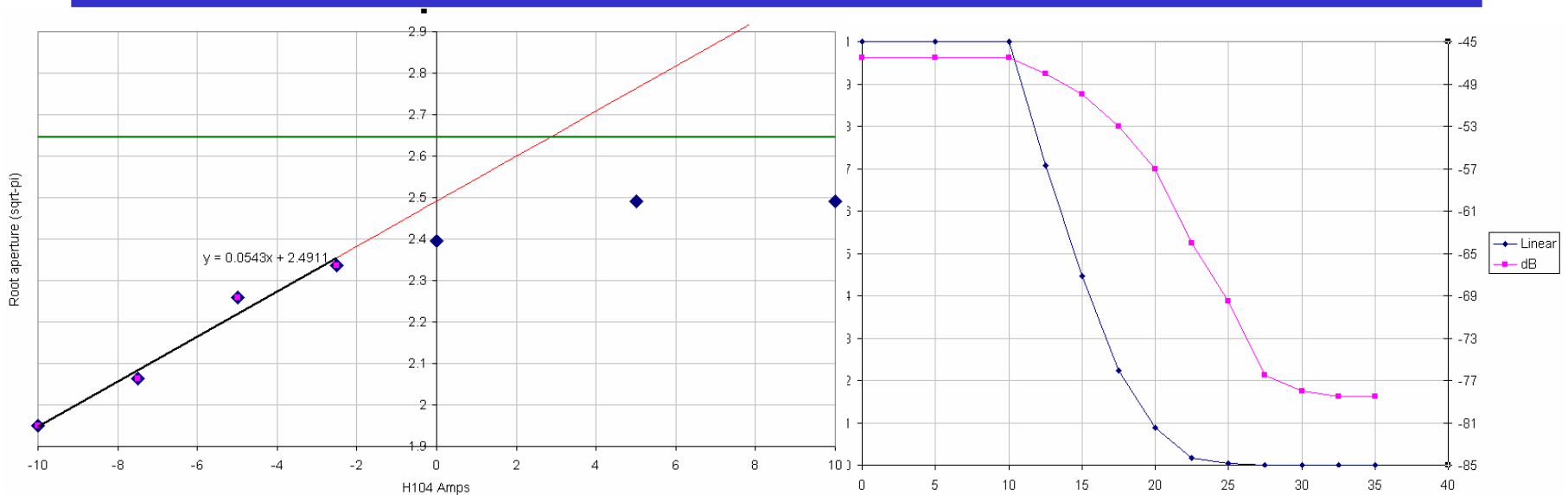
Pbar Studies Summary

- Optimizing Debuncher Vertical Aperture
 - Centering components about new orbits
 - 23 non-magnet components that are movable
 - 70 total motors
 - Half way round on first pass
 - A_y has gone from 16π mm-mrad to 25π mm-mrad
 - On paper should get to 29π mm-mrad
 - Will need to bump around injection septum
 - Will need to bump around apertures from non-movable components

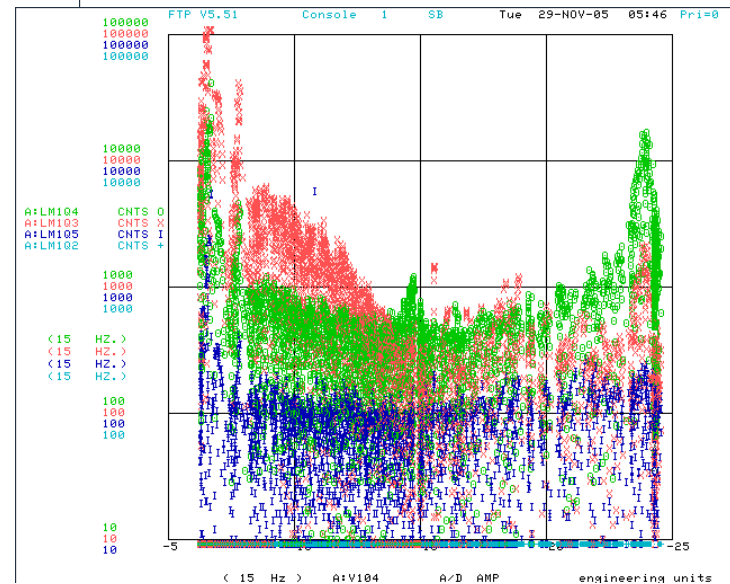
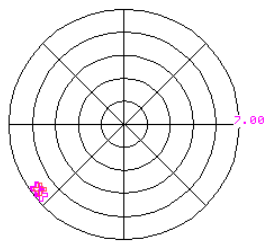
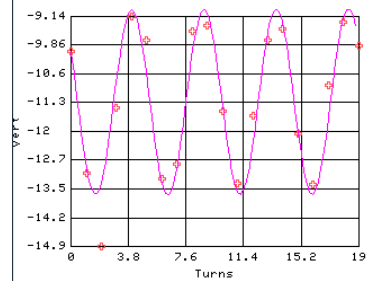
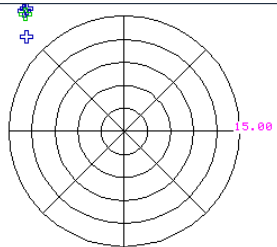
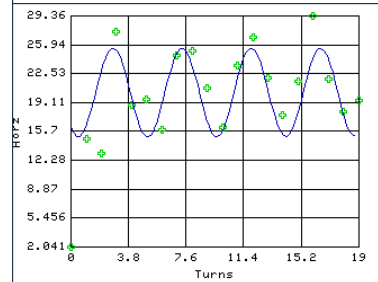
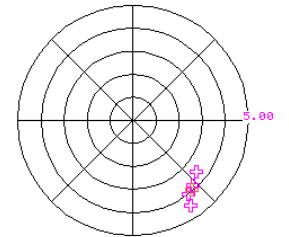
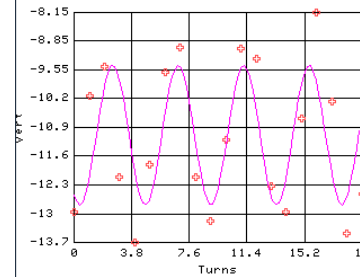
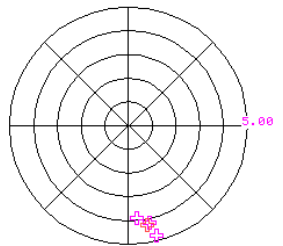
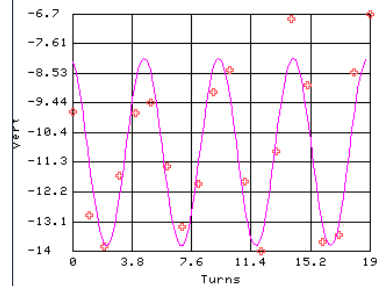
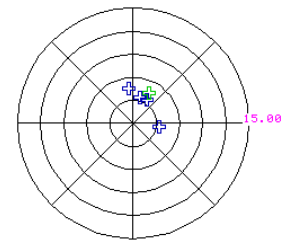
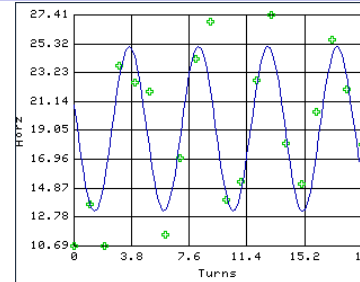
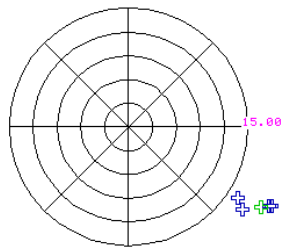
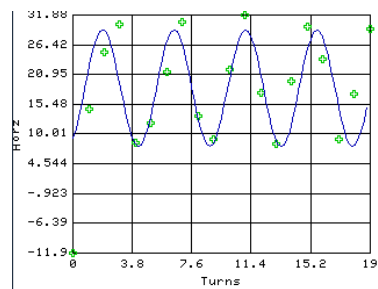
Pbar Studies Summary

- D/A Line Beam Based Alignment
 - Developed technique for setting horizontal position of the injection orbit in the Accumulator
 - Far enough away from the septum for a large circulating aperture
 - Close enough to the septum for a large injection aperture
 - Developed a technique for setting the kicker voltage amplitude
 - Need to measure the effective septum thickness with beam
 - Need to set the injection aperture
 - Horizontally steered the beam through the quad centers with Reverse protons
 - Developed relative TBT technique
 - Only 3 BPMs per plane in the transfer line
 - For the relative TBT technique, the number of effective BPMs gets extended by the number of turns
 - Modulate Quad gradient, look at differences in the TBT vector
 - See a significant amount of vertical steering
 - Originates in the Accumulator
 - Seem to be very close to an aperture edge

Adjusting Injection into the Accumulator



Quad Steering With the Relative TBT



Pbar Study Plan

- Debuncher - AP2 Beam Based Alignment - 13 Shifts
 - Finish Debuncher Movable Devices - 3 shifts
 - Align Debuncher Injection Septum - 4 shifts
 - Remove Quad Steering in the AP2 line - 3 shifts
 - Adjust AP2 optics - 2 Shifts
 - Align Debuncher Injection Septum - 1 Shifts
- D/A Line Beam Based Alignment - 6 Shifts
 - Find Quad Centers in the Accumulator - 2 shifts
 - Correct Accumulator Orbit - 1 shift
 - Adjust Accumulator moveable Devices - 3 shifts
 - Reset horizontal injection orbit and injection channel - 2 shifts
 - Re-steer D/A line - 4 shifts
- Return to Stacking - 6 shifts

Post Study Plan

- Return to stacking when the Tevatron is cold
 - We have touched A LOT of things!
 - We have replaced the lithium lens and installed the pulsed magnet collimator
 - We will not have finished
 - Horizontal alignment of the Debuncher
 - Injection aperture optimization of the Accumulator
 - D/A line steering
- Re-commission the Tevatron - 7-12 shifts
- Run a nominal Tevatron store

Post Study Plan

- Run low luminosity stores requested by the experiments
 - Dzero requests two stores with 1 proton bunch x 4 antiproton bunch at nominal bunch intensities
 - No low beta squeeze
 - No separated orbits (separators off)
 - Parasitic collisions an issue for the experiment?
 - Might have to try a couple of times because of beam-beam effects
 - » Low number of pbars permits quick turnaround
 - Stores separated by a period of time.
 - Both experiments request a $1-3 \times 10^{30} \text{cm}^{-2} \text{sec}^{-1}$ store
 - Small emittances
 - Low bunch intensities
 - Proton intensity looks straight forward
 - Questions on performance of feedback loops in the Main injector for pbar acceleration
 - Meeting on December 6, 9:30 in the Huddle to discuss the plan

Post Study Plan

- Conduct a mini-review of the Pbar studies
 - Status
 - Identify improvements in
 - Software
 - Hardware
 - Technique
 - Prepare new study plan
 - Align the Debuncher Horizontally 13 Shifts
 - Align the D/A Line and optimize the Accumulator injection aperture - 7 shifts
- Conduct a mini-review of 2.5 MHz Acceleration studies
 - Status
 - What is needed to conclude the project?
 - What are the realistic benefits?
 - What are the drawbacks